

1. A database divisional management method for use with a parallel database system having a storage medium, storage and management means for storing and managing a database in said storage medium, and a plurality of access means for accessing said database in response to query inputs, said database divisional management method comprising the steps of:

dividing said database into a plurality of partitions in accordance with the load pattern provided for executing the generated processing procedure; and

2. A database divisional management method according to claim 1, wherein said storage and management means determines the physical addresses corresponding to logical addresses at which said plurality of access means access said partitions of said database.

3. A database divisional management method according to claim 1, wherein said load pattern is determined by the access efficiency of each of said

access means and by the amount of information stored in  
said partitions of said database accessed by said access  
means.

4. A database divisional management method for use with a parallel database system comprising an FES node for generating a processing procedure in response to query input information, BES nodes for accessing a database on the basis of said processing procedure generated by said FES node, an IOS node having a storage medium and capable of storing and managing said database in said storage medium, and a network for connecting the FES, BES and IOS nodes, said database divisional management method comprising the steps of:

calculating the load pattern by which to  
15 perform database processing using said processing  
procedure; and

determining the number of processors assigned to said FES node, the number of processors assigned to said BES nodes and the number of processors assigned to said IOS node in accordance with said load pattern.

5. A database divisional management method according to claim 4, further comprising the step of determining the number of storage medium units of said IOS node and the number of partitions in each of said storage medium units in accordance with said load

6. A database divisional management method according to claim 5, wherein said storage medium units are disk units and wherein the number of disk units of said IOS node and the number of partitions of said disk units are determined in accordance with said load pattern.

8. A database divisional management method for use with a parallel database system comprising an FES node for generating a processing procedure in response to query input information, BES nodes having a storage medium in which to store a database and capable of accessing said database on the basis of said processing procedure generated by said FES node, and a network for connecting the FES and BES nodes, said database divisional management method comprising the steps of:

calculating the load pattern by which to perform database processing using said processing procedure; and

25 determining the number of processors assigned to said FES node, the number of processors assigned to

said BES nodes, the number of storage medium units of said BES nodes, and the number of partitions of said storage medium in accordance with said load pattern.

9. A database divisional management method for use with a parallel database system comprising an FES node for generating a processing procedure in response to query input information, BES nodes for accessing a database on the basis of said processing procedure generated by said FES node, an IOS node having a storage medium and capable of storing and managing said database in said storage medium, and a network for connecting the FES, BES and IOS nodes, said database divisional management method comprising the steps of:

determining the upper limit number of pages  
15 which are accessible in parallel and which require a  
constant time each when said database is scanned for  
access thereto; and

determining the number of processors assigned to said FES node, the number of processors assigned to said BES nodes, and the number of processors assigned to said IOS node in accordance with said upper limit number of pages.

10. A database divisional management method  
according to claim 9, further comprising the step of  
25 determining the number of storage medium units of said

11. A database divisional management method for use with a parallel database system comprising an FES node for generating a processing procedure in response to query input information, BES nodes having a storage medium in which to store and manage a database and capable of accessing said database on the basis of said processing procedure generated by said FES node, and a network for connecting the FES and BES nodes, said database divisional management method comprising the steps of:

determining the upper limit number of pages which are accessible in parallel and which require a constant time each when said database is scanned for access thereto; and

determining the number of processors assigned to said FES node, the number of processors assigned to said BES nodes, the number of storage medium units of said BES nodes, and the number of partitions of said storage medium units in accordance with said upper limit number of pages.

12. A database divisional management method  
for use with a parallel database system comprising an  
25 FES node for generating a processing procedure in

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13. A database divisional management method for use with a parallel database system comprising an FES node for generating a processing procedure in response to query input information, BES nodes having a storage medium in which to store and manage a database and capable of accessing said database on the basis of said processing procedure generated by said FES node, and a network for connecting the FES and BES nodes, said database divisional management method comprising the steps of:

determining the number of processors assigned to said FES node, the number of processors assigned to said BES nodes, the number of storage medium units of said BES nodes, and the number of partitions of said storage medium units in accordance with said expected degree of parallelism p.

calculating the number of pages  $s (=m/p$ ,  
15 wherein  $p$  denotes an expected degree of parallelism) in  
units of sub-key ranges if key range partitions exist;  
and

20 15. A database divisional management method  
according to claim 8, further comprising the steps of:  
calculating the optimum number of accessible  
pages  $m$ ;

calculating the number of pages  $s (=m/p$ ,  
25 wherein  $p$  denotes an expected degree of parallelism) in

having sub-key range partitions in units of s  
pages for inserting data into a disk apparatus.

calculating the number of pages  $s$  ( $=m/p$ ,  
10 wherein  $p$  denotes an expected degree of parallelism) in  
units of sub-key ranges if key range partitions exist;  
and

15 17. A database divisional management method  
according to claim 11, further comprising the steps of:  
calculating the optimum number of accessible  
pages  $m$ ;

having sub-key range partitions in units of s  
pages for inserting data into a disk apparatus.

25 / 18. A database divisional management method



calculating the number of pages  $s$  in units of sub-key ranges if key range partitions exist, said number of pages  $s$  being equal to said optimum number of accessible pages  $m$  divided by said expected degree of parallelism  $p$ ; and

19. A database divisional management method according to claim 13, further comprising the steps of:  
calculating the optimum number of accessible pages m;

20           having sub-key range partitions in units of s  
pages for inserting data into a disk apparatus.

20. A database divisional management method  
for use with a parallel database system comprising an  
FES node for generating a processing procedure in  
25 response to query input information, BES nodes for

accessing a database on the basis of said processing  
procedure generated by said FES node, an IOS node having  
a storage medium and capable of storing and managing  
said database in said storage medium, and a network for  
5 connecting the FES, BES and IOS nodes, said database  
divisional management method comprising the steps of:

detecting a load unbalance on the basis of at  
least one of the load information items consisting of  
the number of accessed pages, the number of hit rows and  
10 the number of communications acquired during execution  
of said processing procedure; and

changing the number of processors assigned to  
said FES node, the number of processors assigned to said  
BES nodes, the number of processors assigned to said IOS  
15 node, and the number of storage medium units of said IOS  
node so as to eliminate said load unbalance.

21. A database divisional management method  
for use with a parallel database system comprising an  
FES node for generating a processing procedure in  
20 response to query input information, BES nodes having a  
storage medium in which to store and manage a database  
and capable of accessing said database on the basis of  
said processing procedure generated by said FES node,  
and a network for connecting the FES and BES nodes, said  
25 database divisional management method comprising the

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detecting a load unbalance on the basis of at least one of the load information items consisting of the number of accessed pages, the number of hit rows and the number of communications acquired during execution of said processing procedure; and

22. A database divisional management method according to claim 20, further comprising the steps of:

assigning the processors and the storage medium  
units anew;

25 / updating the dictionary information necessary

releasing the closing of said key range thereafter if said online processing is still in progress.

25 / 24. A database divisional management method

closing, when online processing is in progress, the key range of a database table if at least one of the three numbers consisting of the number of processors assigned to said BES nodes, the number of processors assigned to said IOS node and the number of storage medium units is to be decreased, said database table being managed by either the processors or the storage medium units to be removed;

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succeeding lock information and directory
information;

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releasing the closing of said key range thereafter if said online processing is still in progress.

25. A database divisional management method  
according to claim 22, further comprising the steps of:  
closing, when online processing is in progress,  
the key range of a database table if at least one of the  
three numbers consisting of the number of processors  
assigned to said BES nodes, the number of processors  
assigned to said IOS node and the number of storage

25 / updating the dictionary information necessary

moving data from the storage medium units to be removed to the storage medium units succeeding those units to be removed; and

27. A database divisional management method according to claim 23, further comprising the steps of:  
10 closing, when online processing is in progress, the key range of a database table if at least either the number of processors assigned to said BES nodes or the number of storage medium units is to be decreased, said database table being managed by either the processors or  
15 the storage medium units to be removed;

                  succeeding lock information and directory  
information:

moving data from the storage medium units to be removed to the storage medium units succeeding those units to be removed; and

25 /releasing the closing of said key range

28. A database divisional management method according to claim 20, wherein either the number of processors or the number of storage medium units for database processing is changed dynamically.

29. A database divisional management method according to claim 21, wherein either the number of processors or the number of storage medium units for database processing is changed dynamically.

30. A database divisional management method according to claim 22, wherein either the number of processors or the number of storage medium units for database processing is changed dynamically.

15                    31. A database divisional management method according to claim 23, wherein either the number of processors or the number of storage medium units for database processing is changed dynamically.

32. A database divisional management method  
20 according to claim 26, wherein either the number of  
processors or the number of storage medium units for  
database processing is changed dynamically.

33. A database divisional management system  
for use with a parallel database system having a storage  
25 medium, storage and management means for storing and



managing a database in said storage medium, and a plurality of access means for accessing said database in response to query inputs, said database divisional management system comprising:

5                    generation means for generating a procedure for  
processing said query inputs;

division means for dividing said database into  
a plurality of partitions in accordance with the load  
pattern provided for executing the generated processing  
10 procedure; and

determination means for determining the number of access means for simultaneously accessing the partitions of said database. ,

34. A database/divisional management system  
15 for use with a parallel database system comprising an  
FES node for generating a processing procedure in  
response to query input information, BES nodes for  
accessing a database on the basis of said processing  
procedure generated by said FES node, an IOS node having  
20 a storage medium and capable of storing and managing  
said database in said storage medium, and a network for  
connecting the FES, BES and IOS nodes, said database  
divisional management system comprising:

25 calculation means for calculating the load  
pattern by which to perform database processing using

said processing procedure; and

determination means for determining the number of processors assigned to said FES node, the number of processors assigned to said BES nodes and the number of processors assigned to said IOS node in accordance with said load pattern.

35. A database divisional management system for use with a parallel database system comprising an FES node for generating a processing procedure in response to query input information, BES nodes having a storage medium in which to store a database and capable of accessing said database on the basis of said processing procedure generated by said FES node, and a network for connecting the FES and BES nodes, said database divisional management system comprising:

calculation means for calculating the load pattern by which to perform database processing using said processing procedure; and

determination means for determining the number of processors assigned to said FES node, the number of processors assigned to said BES nodes, the number of storage medium units of said BES nodes, and the number of partitions of said storage medium in accordance with said load pattern.

36. A database divisional management system

10           determination means for/determining the upper  
limit number of pages which are/accessible in parallel  
and which require a constant time each when said  
database is scanned for access thereto; and

37. A database divisional management system  
for use with a parallel database system comprising an  
FES node for generating a processing procedure in  
response to query input information, BES nodes having a  
storage medium in which to store and manage a database  
and capable of accessing said database on the basis of  
said processing procedure generated by said FES node,

and a network for connecting the FES and BES nodes, said database divisional management system comprising:

determination means for determining the upper limit number of pages which are accessible in parallel and which require a constant time each when said database is scanned for access thereto; and

determination means for determining the number of processors assigned to said FES node, the number of processors assigned to said BES nodes, the number of storage medium units of said BES nodes, and the number of partitions of said storage medium units in accordance with said upper limit number of pages.

38. A database divisional management system for use with a parallel database system comprising an FES node for generating a processing procedure in response to query input information, BES nodes for accessing a database on the basis of said processing procedure generated by said FES node, an IOS node having a storage medium and capable of storing and managing said database in said storage medium, and a network for connecting the FES, BES and IOS nodes, said database divisional management system comprising:

calculation means for calculating the expected degree of parallelism  $p$  according to the load pattern based on said processing procedure; and

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39. A database divisional management system for use with a parallel database system comprising an FES node for generating a processing procedure in response to query input information, BES nodes having a storage medium in which to store and manage a database and capable of accessing said database on the basis of said processing procedure generated by said FES node, and a network for connecting the FES and BES nodes, said database divisional management system comprising:

determination means for determining the number of processors assigned to said FES node, the number of processors assigned to said BES nodes, the number of storage medium units of said BES nodes, and the number of partitions of said storage medium units in accordance with said expected degree of parallelism p.

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